## INTERESTED?

The *Small Commercial HVAC System Design Guide* provides valuable data and recommendations for the integrated design of small rooftop HVAC systems.

Who will benefit from the *Design Guide*?

- Facility owners and managers
- Designers and manufacturers of small packaged HVAC systems
- Companies that distribute, install and maintain small HVAC systems

Key next steps include:

- *Facility owners & managers:* Learn about equipment performance problems and the benefits of fixing them. Require HVAC contractors to follow the best practices recommended in the *Design Guide*.
- *HVAC designers, Distributors, installers & maintenance companies:* Follow the best practices recommended in the *Design Guide*. Check with utility companies for efficiency program information.
- *Manufacturers:* Improve performance through product design changes and reliability enhancements. Support the development of an advanced packaged rooftop unit and a performance-based specification.

This project was part of the *Integrated Energy Systems: Productivity and Building Science* program. To learn more, visit www.newbuildings.org/pier.

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# INTEGRATED DESIGN OF SMALL HVAC SYSTEMS

## BUILDING SCIENCE SOLUTIONS FOR PACKAGED AIR CONDITIONERS

## New Buildings, Broken Systems

Single-package direct-expansion (DX) air conditioners are the workhorses of the HVAC industry, serving 44% of the total floor space of California's new commercial buildings. Packaged systems are popular because they seem affordable, easy to select and install. But in reality they are often have poor field performance due to design, installation, operation and maintenance problems

*A frequent problem: shoddy maintenance*

This project developed comprehensive design guidelines to address the major problems identified during field monitoring and testing of small rooftop HVAC units. These problems include (% of units tested):

- Economizers not working properly (64%)
- Improper refrigerant charge (46%)
- Inadequate ventilation air (38%)
- Fans running during unoccupied periods (30%)
- Simultaneous heating and cooling (8%)

## Optimizing the Performance of Single-Package Rooftop HVAC Units

***Based on this important new study's findings, the researchers developed the Small Commercial HVAC System Design Guide, which provides best practices for the design, installation, and operation of single-package rooftop HVAC systems.***

*Integrated design problems include poor coverage of lay-in insulation and ducts located in unconditioned space*

### *Design Guide topics include:*

- Integrated design strategies
- Unit selection (efficiency, capacity, features)
- Distribution systems (fan power, duct leakage and insulation, ductwork location, building pressurization)
- Ventilation (continuous, demand-controlled, dedicated ventilation systems)
- Thermostats (functionality, default settings, programming, user interface, small energy management systems)

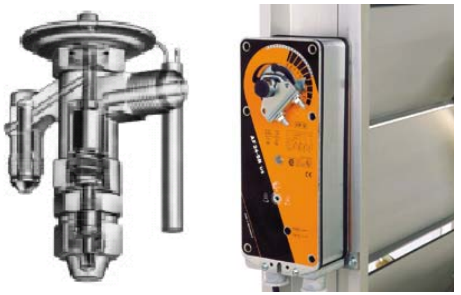
## Best Practices For Comfort & Savings

As this new study shows, most small packaged cooling systems fail to provide optimal comfort, indoor air quality, and energy efficiency. If the systems were designed, installed, operated, and maintained according to the best practices recommended in the *Design Guide:*

- Average building electricity savings would be 8%. Natural gas savings would be 30%.
- Combined average energy cost savings would be $0.26/sq. ft.

If new buildings in California adopted the *Design Guide's* best practices, the following statewide energy savings could be achieved (assuming 10% market penetration the first year and an increase of 1% per year over the next 10 years).

- First-year electricity savings: 6,942 MWh. Cumulative savings over 10 years: 496,360 MWh ($68 million).
- First-year natural gas savings: 97,107 therms. Cumulative savings over 10 years: 6,943,000 therms ($5.8 million).
- Total savings over 10 years: $73.8 million.



*Thermostatic expansion valves and direct drive economizer actuators can improve unit reliability*